Integrating multimedia mercury measurements for the Great Lakes

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Outline

- Description of Hg data summary effort in the northeastern US and eastern Canada
- Identification of biological Hg hotspots
- Linking science with policy
- Establishing a national Hg monitoring program
- How to extend this template to the Great Lakes

Northeastern Ecosystem Research Cooperative Northeast Mercury Research Group

Version 2.0 November 2002

Structure and Timeline

- USDA funding source – Northeastern Ecosystem Research Cooperative. Initiated in 2002

- Hg project was one of several competitively awarded grants in 2002
  - Tom Clair, Environment Canada and myself were the co-P.I.s
  - Basic premise initially to summarize available Hg databases into a web accessible format
  - Data from a designated area of the NE and from freshwater only
  - Provide summarized data on CDs to researchers and policy interests

Workshops

- First workshop in 2002, ~50 participants presented
  - Built committees based on compartment type
- Second workshop in 2003, return of nearly everyone with additional interests
  - Committees presented and reported progress on data summaries
  - First generation of database complete and made into a CD
  - Announced the ability to have a special issue in a peer-reviewed journal
  - Papers were organized and followed data compartments with some inter-compartment analysis
- Third workshop in 2004
  - Senior authors presented their papers
  - Discussed timeline for special issue

>30,000 datapoints

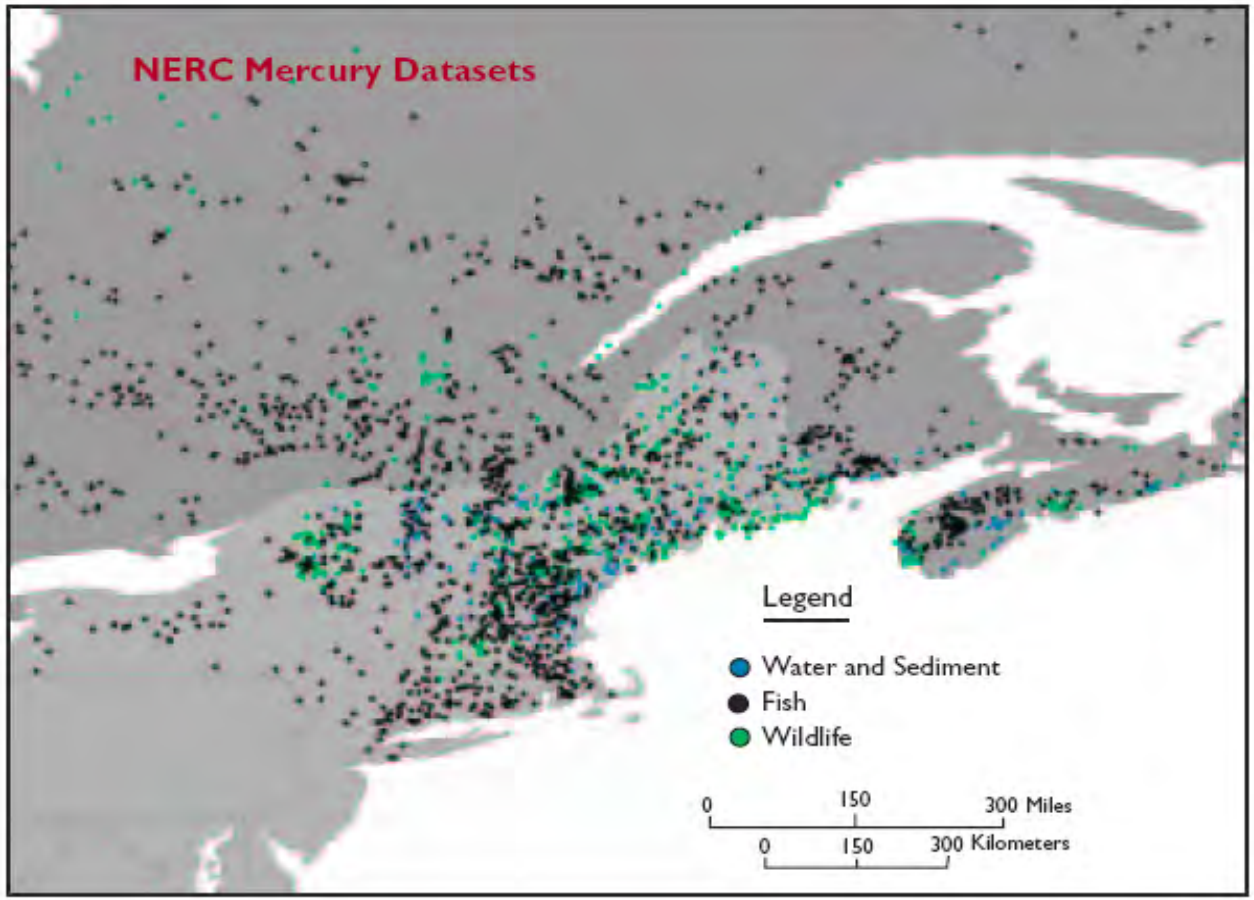


Figure 1: Map of the study area and mercury data compiled by the mercury working group of the Northeastern Ecosystem Research Cooperative. Areas north to Newfoundland, Labrador and central Quebec were in the study area but are not shown here.

Evers, D.C. and T.C. Clair., 2005 *Ecotoxicology* 14(1-2)

71 scientists: American and Canadian

4 years

21 papers

Ecotoxicology Papers

The content for this report was distilled, in large part, from: Biogeographical patterns of environmental mercury in northeastern North America. 2005. *Ecotoxicology.* Volume 14, numbers 1 and 2. Guest Editors: David C. Evers and Thomas A. Clair. Editor: Lee R. Shugart.

1. Mercury in northeastern North America: a synthesis of existing databases. D.C. Evers and T.A. Clair.
2. Approaches to reducing mercury in North America. J. Weiss.
3. Mercury policy and science in northeastern North America: The Mercury Action Plan of the New England Governors and Eastern Canadian Premiers. C.M. Smith and L.J. Trip.
4. Patterns of mercury deposition and concentration in northeastern North America (1996-2002). A. VanArsdale, J. Weiss, G.J. Keeler, E.K. Miller, G. Boulet, R. Brulotte and L. Poissant.
5. Estimation and mapping of wet and dry mercury deposition across northeastern North America. E.K. Miller, A. VanArsdale, G.J. Keeler, A. Chalmers, L. Poissant, N.C. Kamman and R. Brulotte.
6. Long-term atmospheric mercury deposition at Underhill, Vermont. G.J. Keeler, L.E. Gratz and K. Al-Wali.
7. Deconstruction of historic mercury accumulation in lake sediments, northeastern United States. E. Perry, S.A. Norton, N.C. Kamman, P.M. Lorey and C.T. Driscoll.
8. Factors influencing mercury in freshwater surface sediments of northeastern North America. N.C. Kamman, A. Chalmers, T.A. Clair, A. Major, R.B. Moore, S.A. Norton and J.B. Shanley.
9. Distribution patterns of mercury in lakes and rivers of northeastern North America. I.F. Dennis, T.A. Clair, C.T. Driscoll, N.C. Kamman, A. Chalmers, J.B. Shanley, S.A. Norton and S. Kahl.
10. Physical controls on total and methylmercury concentrations in streams and lakes of the northeastern U.S. J.B. Shanley, N.C. Kamman, T.A. Clair and A. Chalmers.
11. Patterns of mercury bioaccumulation and transfer in aquatic food webs across multi-lake studies in the northeast U.S. C.Y. Chen, R.S. Stemberger, N.C. Kamman, B. Mayes and C. Folt.
12. Mercury in the northern crayfish, *Orconectes virilis (Hagen)*, in New England, USA. C.M. Pennuto, O.P. Lane, D.C. Evers, R.J. Taylor and J. Loukmas.
13. Mercury in freshwater fish of northeast North America – a geographic perspective based on fish tissue monitoring databases. N.C. Kamman, N.M. Burgess, C.T. Driscoll, H.A. Simonin, W.M. Goodale, J. Linehan, R. Estabrook, M. Hutcheson, A. Major and A.M. Scheuhammer.
14. Mercury bioaccumulation in two-lined salamanders from streams in the northeastern U.S. M.S. Bank, C.S. Loftin and R.E. Jung.
15. Patterns and interpretation of mercury exposure in freshwater avian communities in northeastern North America. D.C. Evers, N.M. Burgess, L. Champoux, B. Hoskins, A. Major, W.M. Goodale, R.J. Taylor, R. Poppenga and T. Daigle.
16. Mercury levels in Bicknell's thrush and other insectivorous passerine birds in montane forests of the northeastern United States and Canada. C.C. Rimmer, K.P. McFarland, D.C. Evers, E.K. Miller, Y. Aubry, D. Busby and R.J. Taylor.
17. Mercury and other contaminants in common loons breeding in Atlantic Canada. N.M. Burgess, D.C. Evers and J.D. Kaplan.
18. Relating cover characteristics and common loon mercury levels using geographical information systems. D. Kramar, W.M. Goodale, L. Kennedy, B. Carstensen and T. Kaur.
19. Mercury levels in mink and river otter in northeastern North America. D. Yates, D. Mayack, K. Munney, D.C. Evers, R.J. Taylor, T. Kaur and A. Major.
20. Developing a cyber infrastructure for integrated assessments of environmental contaminants. T. Kaur, J. Singh, W.M. Goodale, D. Kramar and P. Nelson.
21. An approach to predict risks to wildlife populations from mercury and other stressors. D. Nacci, M. Pelletier, J. Lake, R. Bennett, J. Nichols, R. Haebler, J. Grear, A. Kuhn, J. Copeland, M. Nicholson, S. Walters and W.R. Munns Jr.

Estimation and mapping of wet and dry deposition across northeastern North America

- Model includes wet AND dry deposition
- Greatest total Hg deposition in:
  - High elevation areas
  - Southern parts of the NE
- Mercury emission sources for the NE are now of concern in PA, WV, OH, and MD.

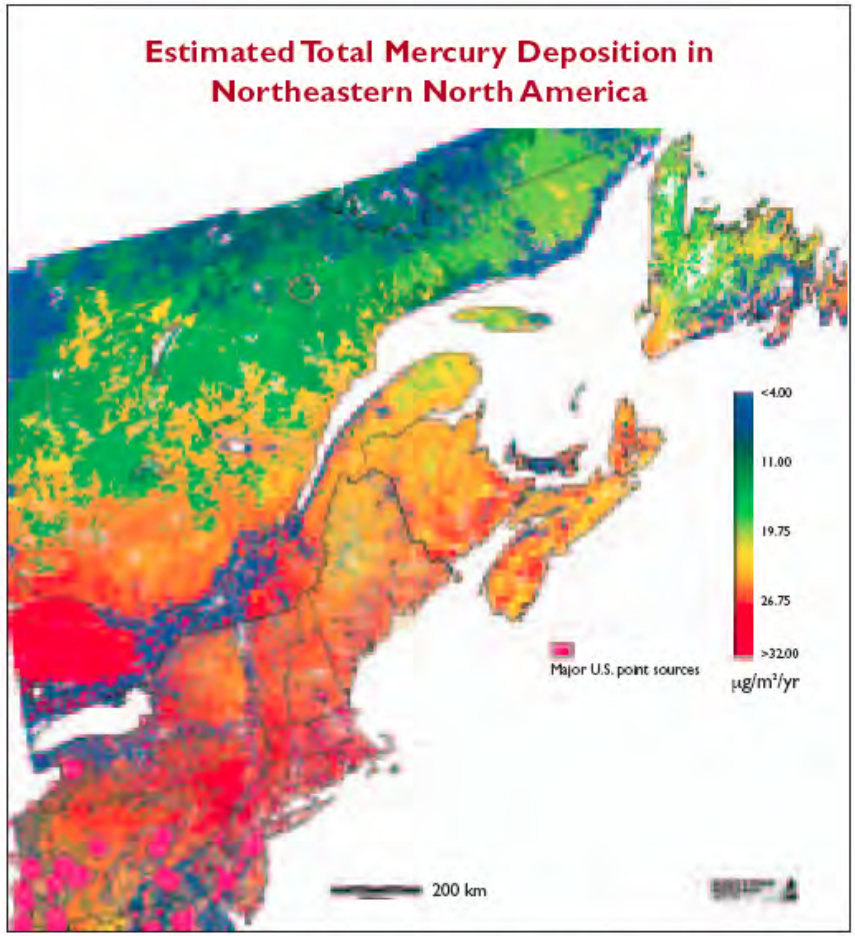
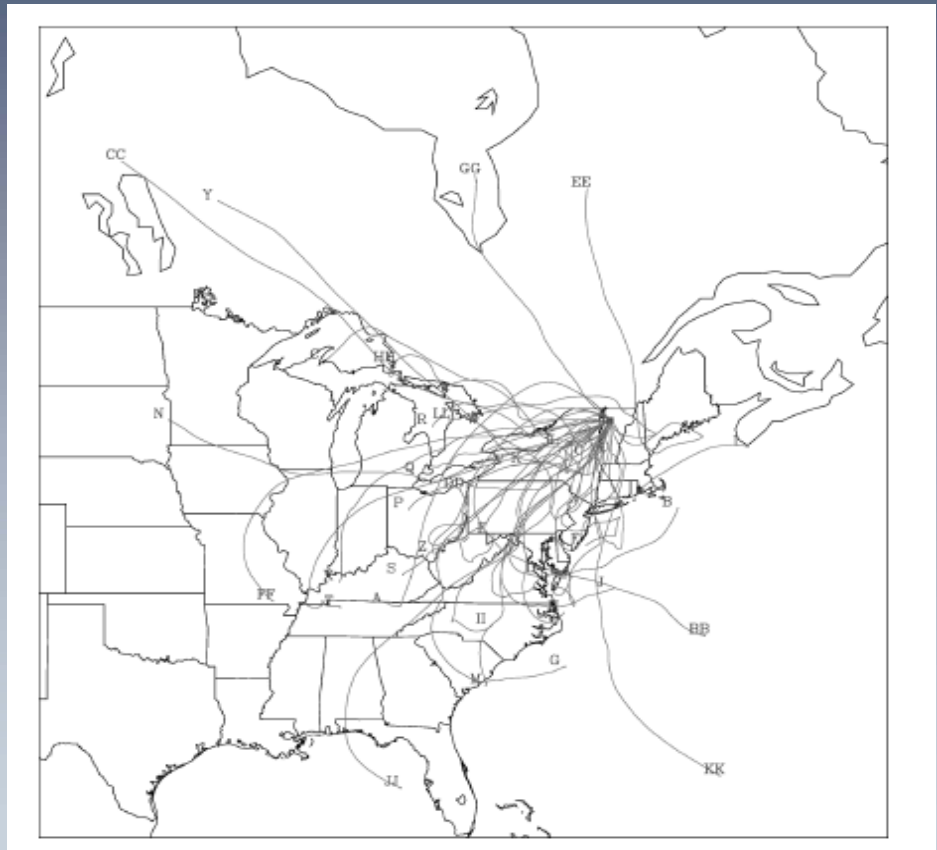


Figure 4: Total mercury deposition based on a new model intended to better depict dry deposition. The model does not fully incorporate the effects of large point sources in the region and those areas are masked in pink.

Miller et al., 2005 *Ecotoxicology* 14(1-2)

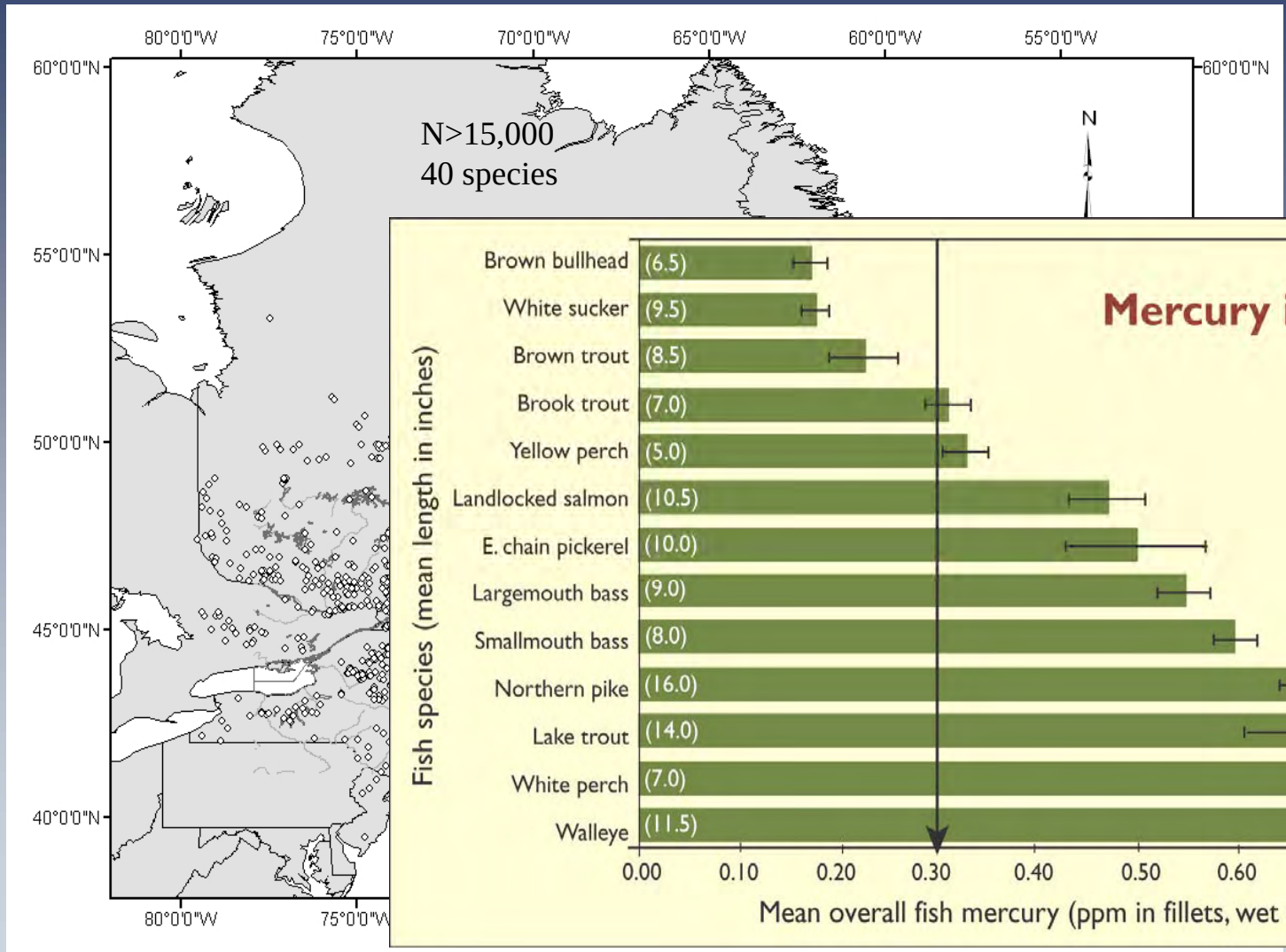
Long-term atmospheric mercury deposition at Underhill, Vermont

- Continuous record since 1992
- Annual mean wet deposition ranged from 7.8 to 10.5 ppt
- Has highlighted seasonality of Hg deposition (higher in spring, summer).
- No clear trend in annual averages, but…
- Significant decreases in the maximum concentrations, ‘92-’03.



Keeler et al., 2005 *Ecotoxicology* 14(1-2)

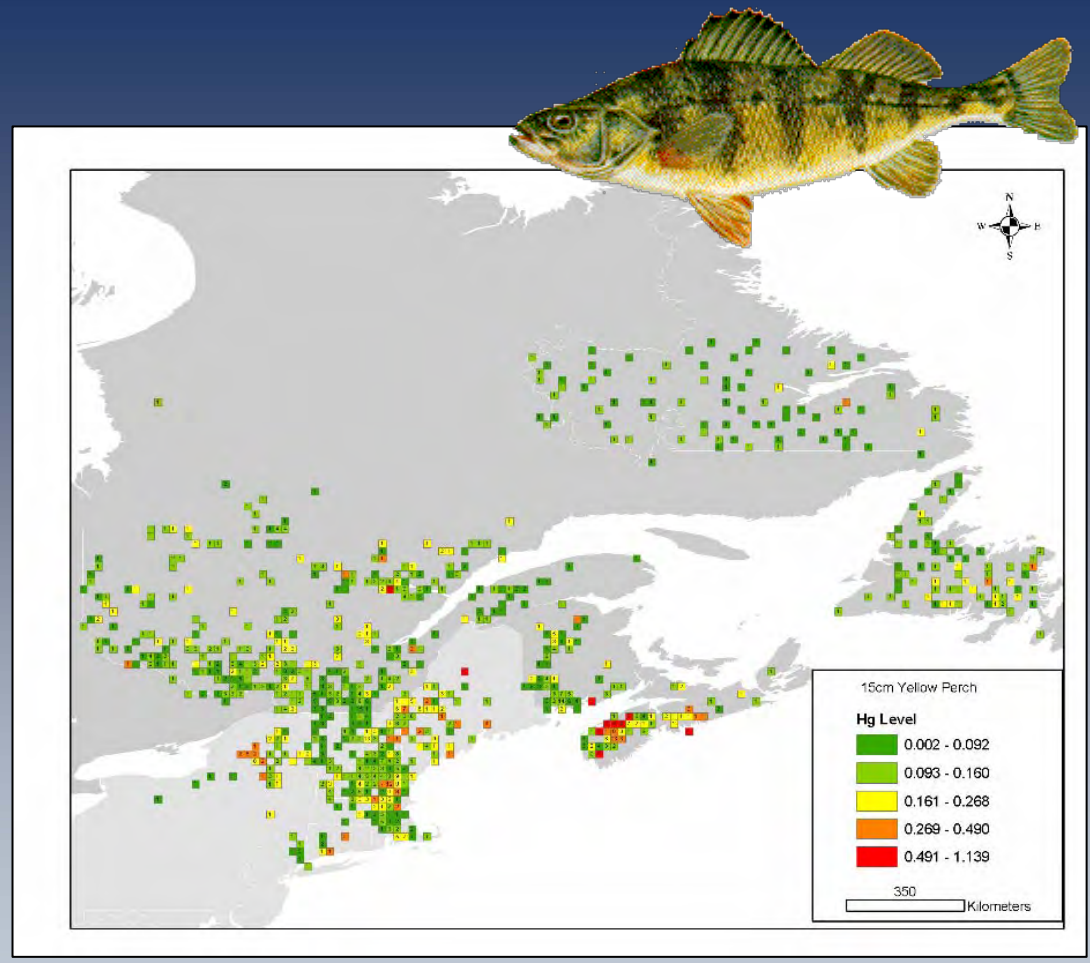
Mercury in freshwater fish of northeast North America: a geographic perspective based on fish tissue



Kamman et al., 2005 *Ecotoxicology* 14(1-2)

Mercury in freshwater fish

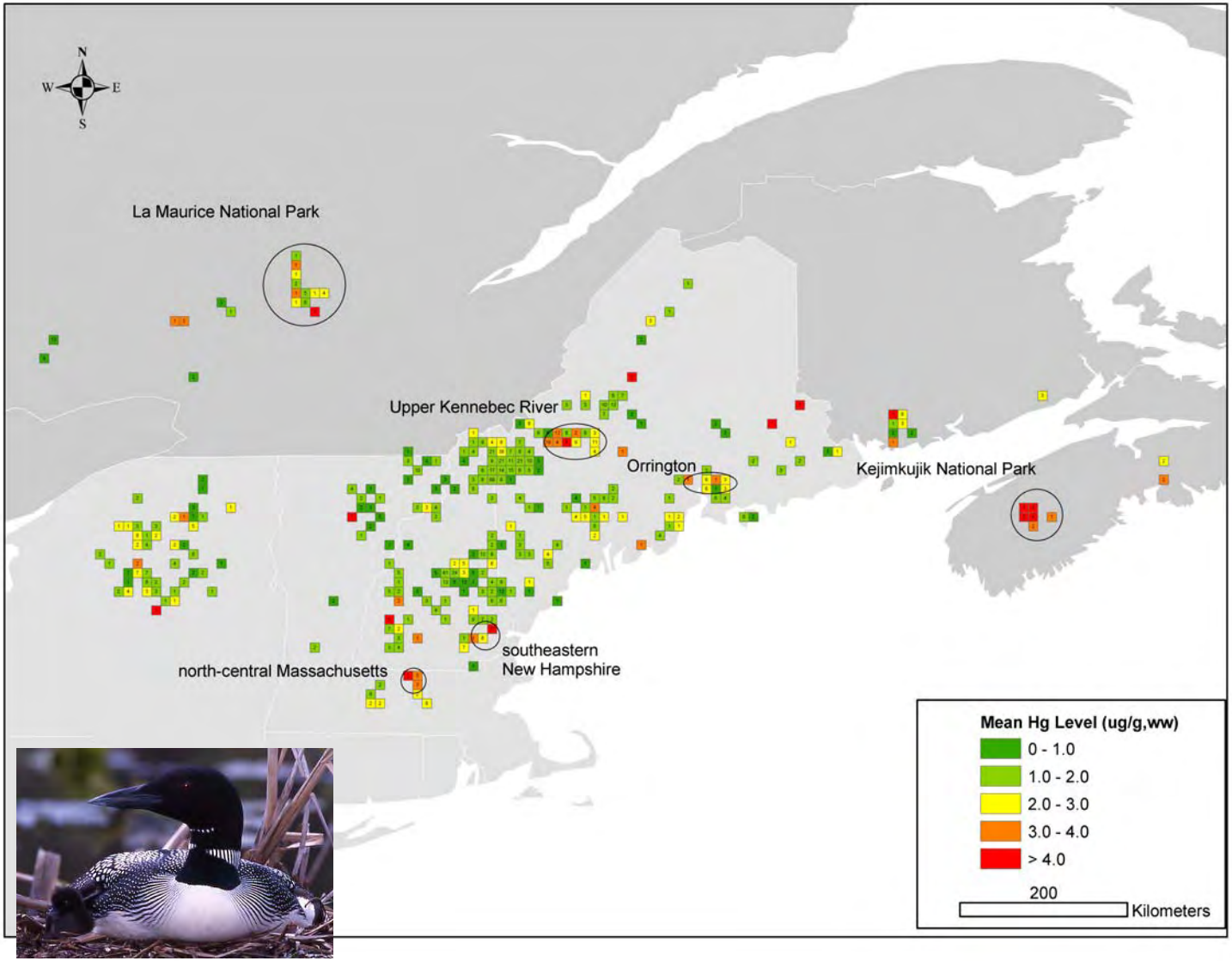
- Four species with the highest mean Hg concentrations were muskellunge, walleye, white perch, and northern pike.
- Several species had greater Hg concentrations in reservoirs, relative to lakes and rivers.
- Waterbodies exceeding EPA criterion for fish Hg (0.3 ppm) ranged from 14% for standard-length brook trout fillets to 42% for standard-length yellow perch fillets.



Normalized deviations from mean tissue levels for yellow perch and brook trout were mapped

Kamman et al., 2005 *Ecotoxicology* 14(1-2)

Geographical influence



Evers et al., 2005 *Ecotoxicology* 14(1-2)

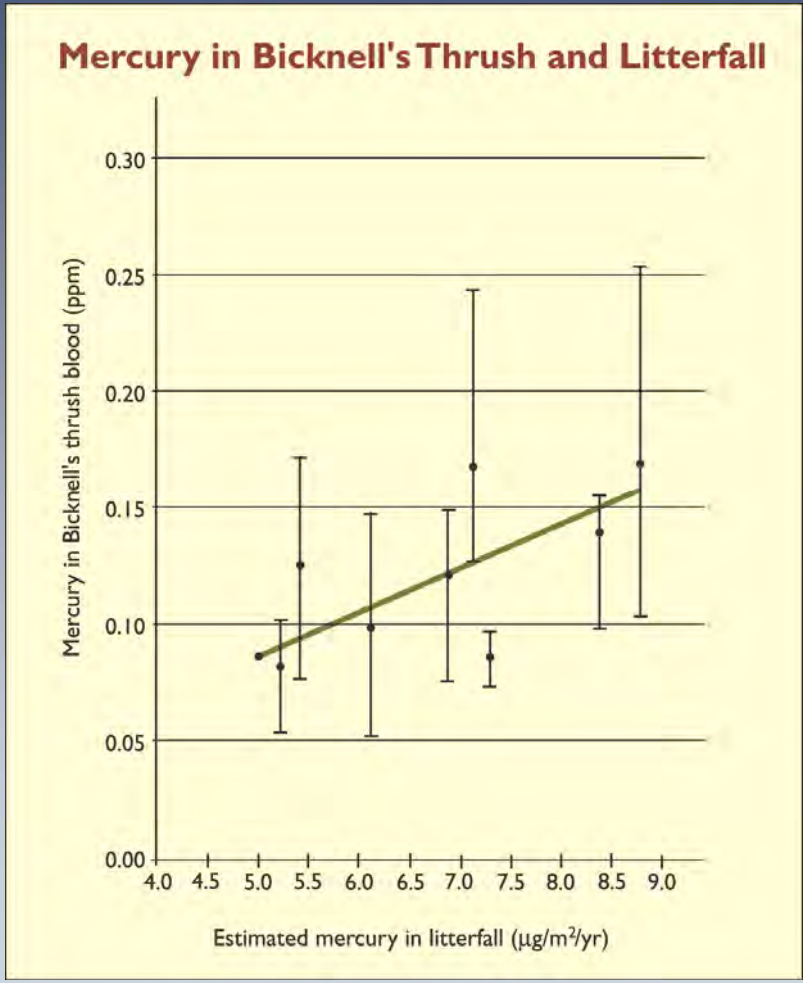
Mercury levels in Bicknell's Thrush and other insectivorous passerine birds in montane forests of the northeastern United States and Canada

Very important ramifications:

1. Terrestrial systems on mountaintops contain available methylmercury for insect-eating birds

2. Important indicator species for high elevation landscapes

3. One of the few demonstrated relationships between atmospheric Hg deposition and biotic Hg levels



Rimmer et al. 2005. *Ecotoxicology 14(1-2)*

Post-project happenings

- Research
  - Emerging issue of concern for organisms feeding in terrestrial habitats and on the insect-foodweb
  - Further identification of hotspots with emphasis on connecting with major Hg emission sources
- Further Publications
  - Two papers in Bioscience on biological Hg hotspots
- Policy
  - Presentations at state and national legislative levels for Hg bills
  - Briefing to USEPA Air Markets Division
  - Development of a House and Senate bill
- National Hg Monitoring Plan

Appalachian Mountain Mercury Network (invertivores)

2005-2006 Efforts

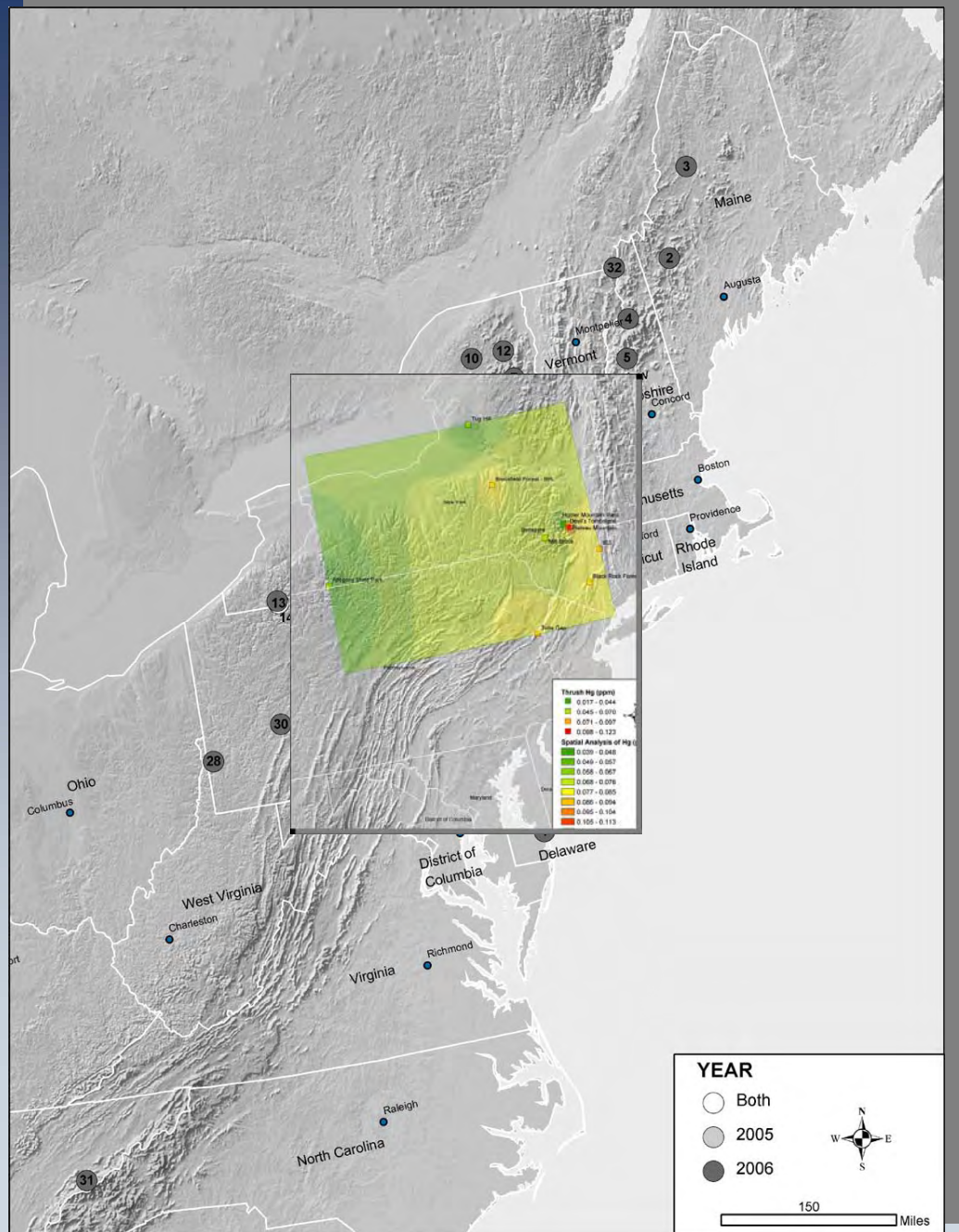
32 sampling stations: birds, insects, soil

Hg and Ca analyzed

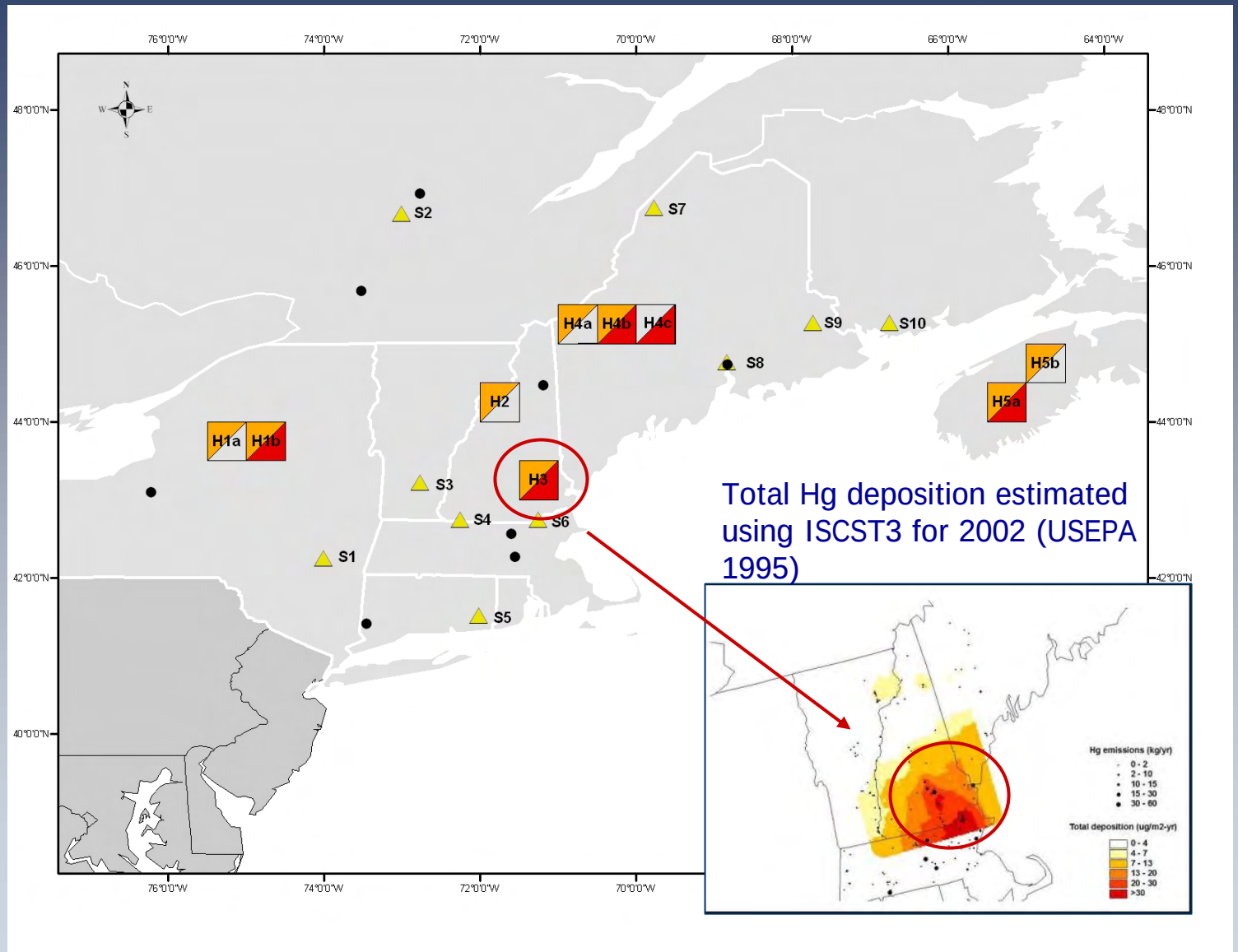
Two interests:

1. Spatial connectivity for MeHg availability

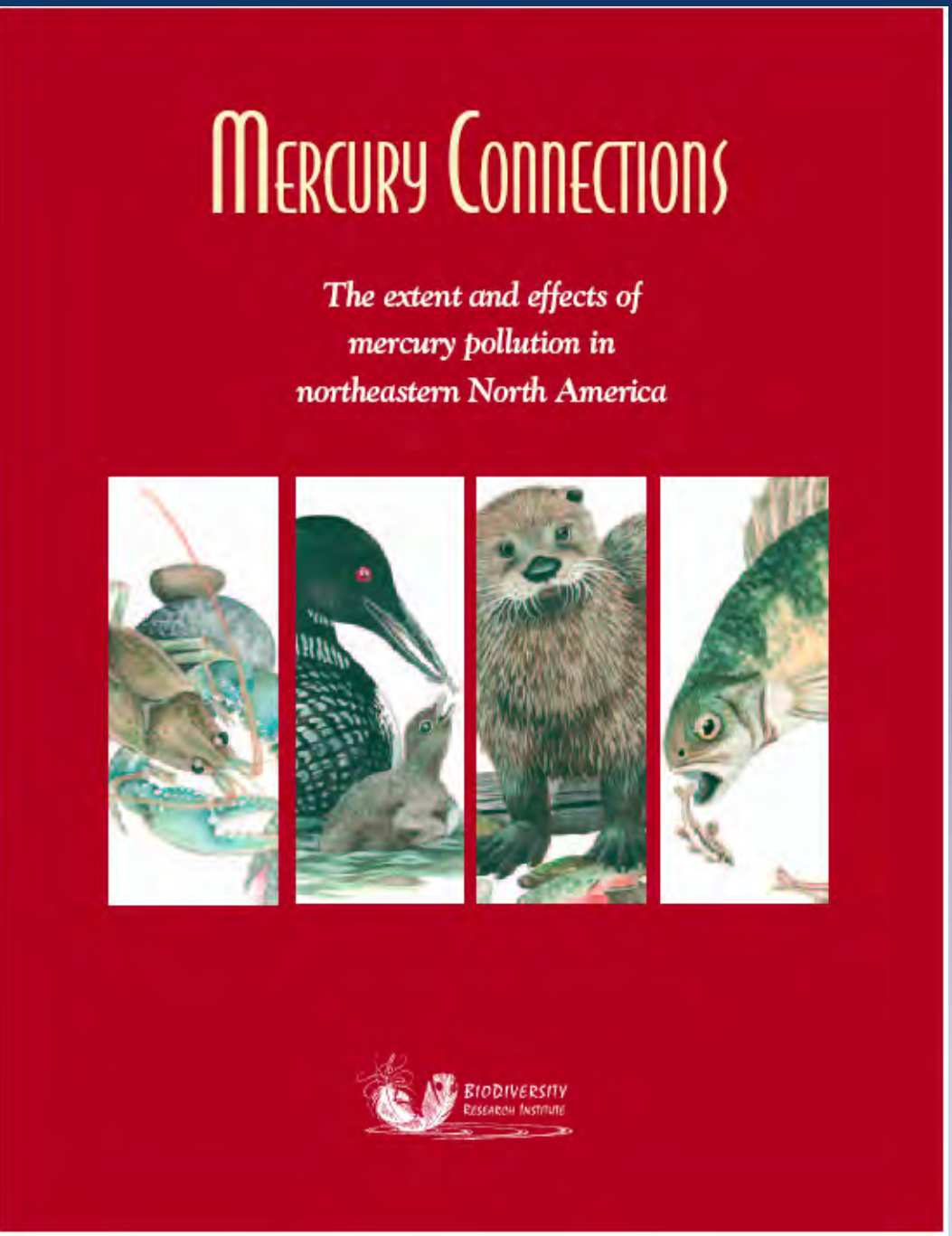
2. Test hypothesis that synergy of high MeHg and low Ca availability in acidic areas negatively impacts songbird populations



Biological Hg hotspots (piscivores)



Evers et al. BioScience 57:29-43.



Linking Science and Policy

- Mid-March 2005
  - Mercury Connections Report (BRI)
  - Congressional briefings
    - Environ. Public Works
    - Senate and Hous
- Early January 2007
  - Mercury Matters Report (HBRF)
  - Congressional briefings
    - Senate and House
  - EPA Air Markets Division

Legislative Bill for national Hg monitoring

Senate and House versions were introduced in March 2007

To provide for the establishment of a national mercury monitoring program.

IN THE HOUSE OF REPRESENTATIVES

Mr. ALLEN introduced the following bill; which was referred to the Committee on _____

A BILL

To provide for the establishment of a national mercury monitoring program.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled

SECTION 1. SHORT TITLE

This Act may be cited as the ‘‘Comprehensive National Mercury Monitoring Program Establishment Act’’

September 2003 Workshop to develop a National Mercury Monitoring Plan

- Organized by Society of Environmental Toxicology and Chemistry, involving 33 mercury researchers
- Funded by U.S. Environmental Protection Agency, Electric Power Research Institute and others
- Rationale:
  - Voluntary and regulatory Hg programs continue to be implemented
  - Need systematic, integrated national monitoring effort
  - Need for more information on environmental impact of specific programs (e.g. rule affecting U.S. coal-fired power plants)

Monitoring Network Structure

- Envision sampling within each of approx. 10 ecoregions in U.S. (or North America)
- Sampling scheme would involve cluster and intensive sites:

	Cluster	**Intensive**
# Sites/ ecoregion	Approx. 15-20	Approx. 1
Selection basis	Similar broad ecological characteristics but different site conditions	Include sites where changing loads are expected
Parameters measured	Primary Hg indicators	Generally primary Hg indicators + additional parameters
Purpose	Identify general trends	Address mechanistic questions (e.g. extent of biota MeHg change associated with changes in Hg deposition)

Mason et al., 2005, 39:14A-22A

Extending this template to the Great Lakes

- Study Area: Great Lakes states and the Great Lakes and Lake Champlain
- Participants: Open to anyone that can contribute Hg databases
- Timing: Three year process
  - Year 1: Organize a workshop, collect available databases, link to current database using standardized format.
  - Year 2: Organize a second workshop and have participants present on titles for their papers
  - Year 3: Publish papers, associate with a media rollout, and present to state and national policy makers

Next Steps

- Find funding source(s)
- Discuss with some of the NERC participants and include relevant ones
- Develop a short-list of interested individuals that can serve as the initial steering committee
- Identify Hg database sources
  - State and federal government
- Identify researchers interested in participating and data sharing

- Contact David Evers, Jon Dettling, or Ed Swain for more information